A DEVELOPMENTAL INVESTIGATION OF THE EFFECTS OF ACTIVE PARTICIPATION AND SELF DETERMINATION IN MEMORY PERFORMANCE

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ABSTRACT

The study was designed to examine possible improvements in the level of recall performance that may result if four and seven year old children are given the opportunity to actively participate in the memory task and are also able to form their own to-be-remembered item pairs.

The memory task took the form of a simple game in which items of real food and toy animals were paired. The child was required to recall these pairings in a subsequent recall trial. The results indicated that seven year olds were unaffected by the imposed conditions. Four year old subjects produced significantly higher recall when they actively participated and self determined the pairing conditions. The performance of four year old girls was particularly high, with subjects who actively performed their own pairings responding at a level close to that obtained by seven year old subjects.

Results were related to current views on metamemory and a body of Soviet research concerned with the use of meaningful material in realistic settings.

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C H A P T E R I

INTRODUCTION AND LITERATURE REVIEW

Belief in the efficacy of learning by doing is firmly rooted in educational practice, especially at the preschool level, principally due to the influence of Jean Piaget (Landreth, 1972). As memory plays an important role in learning of all kinds, the question arises as to whether motor activity during acquisition of material will lead to improved memory performance. To date little work has been done in this area. The purpose of this study is therefore: (1) To examine the role of activity in memory using developmental comparisons and, (2) To determine the effects of subject determined relationships on the to-be-remembered material. The latter question arises out of the work of Wolff and Levin (1972).

DEVELOPMENTAL CHANGES IN MEMORY ABILITY

A large number of studies have demonstrated a developmental improvement in memory performance (see Brown, 1975; Hagan, Jongeward, & Kail, 1975; for reviews). There appears to be a gradual onset of mnemonic competence, illustrated in a study by Flavell, Friedrichs, and Hoyt (1970). Children of varying ages (less than five years, five to six years, seven to eight years and nine to ten years old), were given time to learn the position of ten pictures mounted in a series of windows. The authors observed changes in

memory related behaviour from behind a one way screen. Results demonstrated a clear age related improvement in recall. Only the nine to ten year old subjects effectively monitored their progress and adapted their memory strategies accordingly. The younger children used naming, a primitive memory strategy, throughout the acquisition period.

Although recall memory has been accepted as displaying developmental improvements, until recently recognition memory was thought to be a form of episodic memory (Tulving, 1972), and developmental differences in the recognition of material such as picture arrays would not occur (Brown, 1975). However there was some contradictory evidence (Mandler & Stein, 1974), which pointed to the possible existence of developmental trends. An interesting study by Dirks and Neisser (1976) using complex toy layouts found significant age related improvements in recognition memory. The authors concluded that like recall memory, recognition improves with age. This is at least partially due to the development of effective strategies for storing material (Dirks & Neisser, 1976).

POSSIBLE REASONS FOR A DEVELOPMENTAL IMPROVEMENT IN MEMORY PERFORMANCE

Children of under seven years of age are unable to differentiate memory activity from other forms of behaviour. This results in a failure to implement specific memory directed activities when required (Brown, 1975). A study

by Appel, Cooper, McCarrell, Sims-Knight, Yussen, and Flavell (1972) examined this question. The authors tested the recall of four, seven and eleven year old subjects after 'look' or 'remember' instructions. The stimuli used were 15 pictures taken from five categories. The children were permitted to manipulate the pictures during ninety seconds of free study time. All subjects were then asked to recall as many pictures as possible. The results indicated that only eleven year old subjects showed higher recall under 'remember' conditions. The authors concluded that there was support for the hypothesis that "memorizing and perceiving are functionally undifferentiated for the young child, with deliberate memorization only gradually emerging as a separate and distinctive form of cognitive encounter with external data (Appel et al., 1972, p. 1365)." Young children do not realize that memory requires special strategies.

This lack of awareness of memory phenomena has been termed metamemory by Flavell (1971). Failure to prepare for memory situations has been seen by Kreutzer, Leonard, and Flavell (1975) to result from a lack of knowledge about the interaction of three person and task variables. This lack of knowledge adversely affects memory performance.

(1) Self Awareness of Memory Abilities

Firstly it is important that the child comes to view himself as an individual capable of memorizing material as a result of his own actions. He gradually learns

about his own memory capacity and the limitations of himself and others. In memory situations the mnemonically aware child or adult takes these factors into consideration when planning memory strategies. The study by Flavell et al. (1970) aptly demonstrates this. Included in their results was the finding that only the older children (eleven years) had any realistic idea of their own memory capacity.

(2) Consideration of Task Variables

Knowledge is also acquired about task variables. Children learn that some types of material, e.g. meaningful or related items will be easier to recall and therefore less mnemonic effort will have to be expended to retain them. An experiment by Moynahan (1973) illustrated developmental changes in this area. Nine and ten year old subjects were more likely to choose a categorized list of words as being easier to remember than younger children (seven years old). In the Kreutzer et al. (1975) study, six and seven year olds failed to realize the greater ease of learning lists of opposites. In short, children of more than seven years of age are better able to appreciate the characteristics of different types of material for memory purposes.

(3) Development of Memory Strategies

The third major area accounting for lower levels of performance in younger children is a lack of knowledge about memory strategies. When the mnemonically mature child realizes he is unable to automatically recall certain

material he takes steps to implement behaviours which improve retention, e.g. rehearsal (Brown, 1975). However, this does not mean that young children (less than five years old) are entirely unable to implement simple behavioural strategies when faced with a memory problem.

(a) Use of External Memory Strategies. Preschool children are aware of the value of simple external cues as mnemonic devices. This was illustrated by Wellman, Ritter, and Flavell (1975) using three and four year old subjects. In one condition the children were told that they had to remember the position of objects hidden under four cups that had been used in a game. In a second condition, subjects were simply told to wait. Children in the 'remember' condition displayed significantly more looking and touching behaviour during a delay period than those who were 'waiting'. It should be mentioned that there was no difference in subsequent recall between the two groups.

Kreutzer et al. (1975) tested knowledge of retrieval strategies by giving young children the problem of finding a lost jacket. Even the youngest group (five years old), could think of a least one simple strategy. This generally involved relying on external prompts such as writing, taping and asking others. The high level of memory for spatial location of concrete objects (Wellman et al., 1975) may be due to the use of external cues and the fact that young children are likely to practise this form of memory in everyday life.

As part of the larger study mentioned above, Kreutzer et al. (1975) asked young children aged from five to six and a half years questions about the nature of learning, remembering and forgetting. The answers they obtained indicated that young children at least have global concepts of remembering and forgetting; for example, they appreciated the fact that things that happened a long time ago are hard to remember and that longer study time is likely to lead to better subsequent recall.

Children of less than five years of age appear to have at least a broad appreciation of the possibilities of memory. This awareness could be exploited by introducing conditions that would increase the level of memory performance of these children.

(b) The Development of Internal Memory Strategies

The use of internal memory strategies involves a greater awareness of metamemorial processes. Accurate judgement needs to be made of the state of one's own memory and plans must be made for future retrieval. It is not until well into middle childhood that even moderately effective use of internal memory strategies is acquired (Brown, 1975). Flavell et al. (1970) studied a wide range of strategies used by children when learning a display of ten line drawings. They found that younger children (up to nine and ten years of age) relied principally on naming, while older children introduced new strategies to cope with their currecnt level of learning, moving from naming to

cumulative rehearsal, anticipation and gesturing. This suggests that the older subjects were monitoring acquisition and modified their strategies accordingly. The ability to organize material for subsequent retrieval is important, as is recognizing and utilizing existing structure and meaning in to-be-remembered material for subsequent effective retrieval.

In summary it can be seen that with increasing age the child develops a greater degree of knowledge about memory and becomes more flexible in employing acquired memory strategies. Thus age related differences in level of performance are likely to be found in any memory task requiring the use of memory strategies or a level of mnemonic awareness.

THE SOVIET APPROACH TO MEMORY DEVELOPMENT

Using a different approach, developmental differences in memory performance have also been found by Soviet psychologists. They have demonstrated the superiority of involuntary memory (memory which arises from the goal of another activity), over voluntary memory (memory resulting from a conscious intention to remember) in children of less than seven years of age. This trend becomes reversed in older children (Yendovitskaya, 1971).

In some ways a parallel can be drawn between the incidental and intentional memory of Western psychologists and the involuntary and voluntary memory of the Soviets. The developmental trends are the same with children under

seven years of age retaining more material on incidental and involuntary type tasks than in intentional and voluntary tasks. This is mainly due to the lack of metamemorial skill in young children.

However there is one fundamental difference between the two models. In the Soviet model the goal of the activity is the important factor in determining involuntary or voluntary retention, whereas the intention of the subject is all important in distinguishing incidental from intentional memory.

ACTIVITY AND ITS ROLE IN DEVELOPMENT

Soviet Views on the Importance of Activity

In psychology the problem of activity has been largely ignored in favour of an emphasis on internal states (Leont'ev, 1975). In line with political doctrine, Soviet psychologists emphasize the importance of activity and external influences in shaping the behaviour of the individual. Kussman (1976) states. "Activity is a global process in which the individual structures and organizes his relations to his social and material envionment (p. 127)." Activity in this model is conceptualized as a bridge between the individual and his environment. It is a two-way process involving action by the individual outwards, orienting him in the external world with the simultaneous inward influences of his cultural context.

The impact of culture on memory performance was demonstrated in a study by Meacham (1975). He saw patterns of memory development as reflecting what had to be

remembered in daily activities. Subjects were drawn from the urban United States and rural areas of Guatamala. In this study Meacham was principally concerned with memory for objects and their location. He postulated that as there was a lack of diverse objects in the rural area, residents would not need to make accurate discriminations between them in their everyday lives. This would result in poor retention of similar objects due to confusion between items. Recall for location, on the other hand would be more common in daily life. As expected the results revealed different patterns of object and place recall between the two cultural groups, suggesting that environment and culture can contribute to the developmental patterns of mnemonic abilities.

The most fundamental form of human activity is "external sensory practical activity (Leont'ev, 1974, p. 22)," and not the inner activity generally studied by psychologists.

Implications for Development

The Soviet concept of activity has important implicactions for development (Podd'yakov, 1974), as the infant's only way of interacting with the environment is physical and according to Elkonin, (cited in Smirnov & Zinchenko 1969) the development of the infant in the motor sphere increases his contact with the surrounding world. At this early stage, activity by the child has the vital role of widening the child's experience and therefore increasing his learning. Even with the beginnings of internalization the links with external activity are

maintained because inner activity has the same structure as external action, both arising from the latter.

The Soviet model propounds a stage approach to development and within each stage a particular activity is predominant. For example, play is the predominant activity in early childhood. "It is within the context of this leading activity that mental processes are reorganized (Meacham, 1977, p. 276)." Again, social and historical conditions are vital in that they influence the form taken by the leading activity.

Activity can be seen to have considerable importance for memory, especially involuntary memory. It has been shown that material central to the goal of an activity will be remembered better than material that is not directly related (Smirnov & Zinchenko, 1969; Zinchenko, cited in Yendovitskaya, 1971). This is because a particular goal orients the individual to his task and thus material most relevant or related to the goal will be retained

The Piagetian Concept of Activity

The importance of activity for development has also been emphasized by Piaget who is very much a proponent of the active organism. From infancy the child actively reaches out and engages his environment, through action knowledge is acquired, with cognition being expressed by actions (Piaget, 1974).

An important aspect of Piaget's developmental theory is the transition from a dependence on external reality to internalization of action. This gradually takes place

during the preoperational period and the child is no longer limited to the pursuit of concrete goals.

Activity and Educational Practice. Piaget's emphasis on action has wide implications for educational practice (Flavell, 1963). Essentially education must follow the course of internalization of actions. New work should be presented in as concrete and action oriented form as possible, involving manipulation and experimentation. Once the operating principle has been isolated learning should become more internalized, encouraged by the use of symbols and representation. Although the sensorimotor stage is the one most directly concerned with action, actions are seen by Piaget as the "raw material of all intellectual and perceptual adaption (Flavell, 1963, p. 82)." According to Piaget, the preoperational child (two to seven years), although capable of forms of representation tends to use concrete and more static images of reality for cognitive operation with older children manipulating mental replicas of objects and events rather than simply conducting "mental experiments" (Flavell, 1963, p. 158) in which actual objects are mentally manipulated.

Activity has been shown to play a vital role in a large body of developmental theory, it is the means by which the child comes to terms with his environment and as a result learns from this encounter. It is not surprising that a number of studies have been undertaken with the specific aim of determining the importance of active participation in the learning process.

Activity Studies

Imagery as a Mnemonic Aid. The facilitative effects of motor activity on the formation of dynamic imagery have been indicated by several studies (Wolff & Levin, 1972; Wolff, Levin, & Longobardi, 1972, 1974). From this work it would appear that manipulation of object pairs (in a paired-associate learning situation) leads to the formation of an interactive or dynamic image in Piagetian terms. The assumption was made by these workers that imagery facilitates learning. Evidence for this has come from the finding that imagery instructions improve paired-associate learning in adults (McCabe, Levin, & Wolff, 1974; Pavio, 1972). Reese (1977) proposed that imagery provides a structure around which to-be-remembered material can be organized. Wolff et al. (1974) have shown that imagery *per se* does not facilitate memory, it must be in the form of an interaction between stimulus items, termed compound or dynamic imagery. Young children do not produce dynamic imagery as readily as adults. The paired-associate learning of adults can be improved by giving them instructions to use visual imagery. If the same instructions are given to children there is little improvement in their learning performance (Bender & Levin, 1976). It is therefore necessary to impose some form of elaborative strategy in the form of an introduced interaction if the paired-associate learning of young children is to be enhanced (McCabe et al., 1974).

Manipulation of objects has been shown to improve the paired-associate learning of preoperational children (Wolff & Levin, 1972; Wolff et al., 1972, 1974). It would therefore appear that if these children are given the opportunity to manipulate objects, they will be able to form some sort of representation of the objects that will aid in subsequent retrieval (Levin, 1976).

Problems in Separating Activity, Contact and Interaction. However, there are problems in isolating activity, contact and interaction as Yuille and Catchpole (1973) pointed out. They felt that the earlier work of Wolff and Levin (1972) had confounded contact and interaction. Only the subjects who were in contact with the object pairs saw the objects in an interaction. In this design the causal factor for any improvement in learning cannot be isolated. Yuille and Catchpole (1973) designed a training procedure to facilitate imagery formation in children. In doing so they attempted to isolate variables crucial to the formation of images. The three they examined were: Concreteness, contact and interaction. Yuille and Catchpole (1973) interpreted their results as implying that only the provision of an interaction improved paired-associate learning.

A later study by Wolff et al. (1974) used yolked pairs with one subject physically forming the interaction while the other observed, thus isolating contact and interaction. The results showed that over a twenty-four hour period subjects who had actually formed the interaction produced

a higher level of recognition performance that the observers.

The failure of Yuille and Catchpole (1973) to isolate contact as a significant variable in improving the paired-associate learning of children may be due to the fact that they used seven year old subjects who, according to Wolff and Levin (1972) should be able to spontaneously generate dynamic imagery. The subjects in the Wolff and Levin (1972) study were five years old and not able to generate dynamic imagery. The different age groups used in the two studies may account for their conflicting results.

Activity and Strategy Transfer. Active manipulation has also been shown to be important in improving strategy transfer. The desired strategy used by Borkowski, Lever and Gruenenfelder (1976) was the use of prepositions to join paired-associate items. The results showed that active manipulation alone and active manipulation plus a short film showing a child demonstrating active strategy based acquisition and recall led to improved strategy transfer and consequently better recall in four year old children. Active manipulation during the acquisition period would appear to be an important factor in improving retention

Activity as an Aid in Concept Acquisition. Motor behaviour has also been shown to be a factor in aiding concept acquisition in children. Conceptual development is thought to progress through a series of stages beginning with perceptual encounters with concrete objects or events. According to Klausmeir (cited in Nelson, 1976) concept

acquisition itself is divided into four major levels of attainment: Concrete, identity, classificatory, and formal. Younger children operate only at the lower levels. Nelson (1976) examined the effects of different types of experience on concept acquisition training. Subjects were to acquire the concept of an equilateral triangle and experienced a series of blocks in combinations of visual, motor and verbal. Results indicated that motor and verbal training led to relatively better performance for three and five year old children. Nelson (1976) also showed that motor behaviour helped five year olds acquire higher conceptual levels. The author suggested that these experiences may be important in improving attending and discriminating.

The results of these studies seem to indicate that motor activity or manipulation of to-be-remembered items leads to an increase in the level of attending or awareness which in turn may result in an improvement in a number of different types of learning.

SELF SELECTED RELATIONSHIPS BETWEEN ITEMS

It has been shown above that young children are unable to spontaneously form images which help in future retrieval. Imposed imagery in the form of elaboration does however lead to improved performance. This involves the creation of an interactive relationship between items (Varley, Levin, Severson, & Wolff, 1974). The creation of a memorable

link between two items can thus be shown to improve the retention of these items.

Mal'tseva (cited in Smirnov, 1973) found that aids (visual and verbal) invented by the subjects were more effective for aiding memory than those imposed by the experimenter, (subjects were seven years and above). Presumably subject devised aids had more meaning for the subject. Mal'tseva also found that older subjects generated more of these aids. It would also be expected that aids generated by the older subjects would be more effective. This is supported by the work of Moynahan (1973) and Tenney (cited in Hagan et al., 1975). Tenney found that older children (eight to eleven years old) were better able to generate lists of words that would be easy to remember than younger children.

Danner and Taylor (1973) compared the effects of recall of noun relations imposed by the experimenter. As expected only the six to seven year old children benefitted from imposed relations whereas eleven year olds recalled more items when they spontaneously generated relations. This result is possibly due to the fact that young children are unable to generate specifically memorable interactions due to a low level of metamemorial development. A similar result was obtained by Wolff and Levin (1972) who found that experimenter produced interactions led to a higher although not significantly higher level of paired-associate learning in young children. This may have occurred because the experimenter produced more memorable interactions. In the Wolff et al. (1974) study this problem was removed

however it is still difficult to say whether the act of actually creating the interaction, i.e. self determination, or the motor activity involved leads to improved memory performance, the yolked procedure of Wolff et al. (1974) did not separate these variables.

One aim of the present study was to sort out this problem by comparing levels of memory performance under conditions of self determined and experimenter determined relationships, with the subject actively participating in or passively watching the initial item pairing.

THE IMPORTANCE OF AN ECOLOGICALLY VALID SITUATION

Memory is of vital importance to adaptive functioning in the outside world. Smirnov and Zinchenko (1969) see memory functioning to "orient the individual in the context of its experience (p. 453)." Memory cannot be examined in isolation. The product of memory operations is often the result of an interaction with the environment and the subject's existing knowledge. According to Yendovitskaya (1971) a child retains what he contributes to the environment, it is not a passive reaction to the stimuli, again emphasizing the importance of action. Despite the importance of memory in the real world the majority of studies designed to examine the operation of memory processes have been conducted in the laboratory using materials and procedures far removed from reality. For example, Morrison and Haith (1976) examined memory capacity. They briefly presented visual arrays of two,

three or four geometric figures to subjects of different ages for subsequent recognition. Hoffman and Dick (1976) used single displays of up to 600 featureless pictures to investigate developmental differences in recognition memory. Each picture was carefully chosen to remove any distinguishing features. Neither situation is likely or even possible in real life. Indeed, seldom in real life does material have to be exactly reproduced and when this is required, external memory aids such as pen and pencil are usually available. Direct experience reveals that rote rehearsal is a seldom used mnemonic. To-be-remembered material is usually related to what is already known or a mnemonic is constructed (Neimark, 1976).

Istomina (1975) carried out an interesting experiment which examined memory performance in different situations. The first situation was a traditional laboratory in which to-be-remembered items consisted of a list of unrelated words. The second was a play situation in which the child participated actively in a shopping game. The requirements were that the child had to remember the names of objects to be bought at the shop. Istomina saw the differences between these two situations to be motivational. In play memory is directly related to the central activity, i.e. remembering items on the shopping list, which is central to successful performance in the game. In the laboratory situation the child is motivated by a desire to interact with the experimenter, retention of the list of words is not directly related to this motive. Istomina postulated

that for a child to memorize the material it had to have an intrinsic relation to the central activity. The results supported this idea, memory performance was at a higher level in the play situation for all age groups (three to seven years). As part of the observation Istomina recorded types of memory behaviour displayed by her subjects. Memory behaviour and type of recall were divided into three levels. In the first, the child failed to appreciate the requirements of the task. A child who was functioning on the second level of remembering was able to isolate the requirements by carrying out the task as quickly as possible, making no attempt to recall forgotten material. At the third level, simple strategies were used and the child tried to recall material he had forgotten. Istomina found that children in the play condition were able to function at least on a level above children of the same age in the laboratory task. This would indicate that children are more likely to exhibit optimal memory performance in a play situation.

Use of Meaningful Material

Paris and Lindauer (1976) and a number of Soviet studies (Smirnov & Zinchenko, 1969) have examined memory for narratives. Results indicate that even very young children can recall the meaning of a story as it relates to the central core of the narrative or activity. It would appear then that even young subjects can readily extract the main theme from meaningful material. The presentation of simple meaningless material, for example

lists of unrelated words, presents a more difficult task as subjects have to attempt to impose structure and meaning on inherently unrelated and meaningless items. Results obtained from studies of this kind will not be readily generalizable to real world situations. It is only as material grows more complex that subjects will be able to create relationships between their own existing knowledge and skill, and the instructions and material of the task. "If the head is given stupid things to do by 'brute force' it can only do relatively stupid things with the task (Jenkins, 1974, p. 285)."

Research has indicated that if a meaningful task is carried out on to-be-remembered material, memory will be better than if the subject performed a meaningless operation. Bower, Karlin, and Dueck (1975) found that recognition of pictures over a period of one week was enhanced by semantic comprehension. Mandler and Day (1975) showed that memory for orientation of forms was at a higher level for meaningful and opposed to complex meaningless forms. Similar results were obtained by Fleury (1974) and Nelson (1971) using pictures.

From these studies it becomes clear that studies designed to approximate real life can reveal important factors underlying memory development which may not be apparent in the purer laboratory tasks. To obtain the best results from children the situation used need to be meaningful for them in that it readily fits into their experience. A play situation would appear to be the most relevant, at least for children of less than five years old.

Use of Concrete Objects in a Memory Task

To make an experimental situation as meaningful as possible for children the materials used should be as concrete as possible. Standing (1973) points to the importance of studying concrete memory. Abstract stimuli involve symbolic processes and because of this, concrete stimuli will be more numerous and have more meaning for subjects (especially children). A great deal of interest has been shown in picture memory (Hoffman & Dick, 1976; Standing, 1973), a form of concrete learning which is very efficient. Three dimensional objects have not been widely used in memory studies. This is a serious omission as objects are more realistic than pictures. In experiments with children, concrete objects are more likely to fit into their existing experience and hence will have more meaning for them. There is some evidence that objects are better remembered by young children than photographs or line drawings (Evertson & Wicker, 1974; Iscoe & Semler, 1964). However there are contradictory findings (Yuille & Catchpole, 1973).

Most of the studies using objects have used them in an experimental setting in which they have been randomly paired in a meaningless way (Wolff & Levin, 1972). Two studies (McCabe et al., 1974; Wellman et al., 1975) have attempted to utilize a game situation. Wellman et al. (1975) used a story to provide a framework for the memory task which involved the experimenter hiding toy animals

under small cups. The children were subsequently asked to locate the animals. However there needs to be more work done, especially in the developmental area to determine the mnemonic abilities of children in meaningful situations.

The present study used objects as stimuli in a game situation similar to that used by Istomina (1975). The studies to be reported involved toy animals which were 'fed' real foods in a pretend meal situation, the children's task was to remember what each animal had 'eaten' on a previous occasion so that they could be given the appropriate food for the present meal.

C H A P T E R I I

PILOT STUDY 1

Pilot work was undertaken with the primary assumption that memory tasks would produce developmental differences in the level of performance.

The original intention of this research was to determine whether hiding to-be-remembered items from view during the acquisition period would have any effect on the level of memory performance in children of different ages. It was postulated that older children (seven years and above) would be unaffected by the absence of to-be-remembered items as they would be able to spontaneously generate dynamic images of the items (Wolff & Levin, 1972). Younger children (five years and under) would be unable to do this and therefore would be expected to show a lower level of memory performance than in conditions where items were visually present.

METHOD

Memory Task

The memory task took the form of a simple game in which the children pretended to feed toy animals with real items of food (refer to Pilot Study 2 for a detailed description of the stimulus materials). The aim of the task was to create a number of animal-food pairings which

could be retained by the child. The level of memory was assessed by requiring the child to 'feed' all the animals the same foods at a subsequent pretend meal.

Subjects

Eight four year old subjects (mean age 4.6 years) were randomly selected from Riccarton Kindergarten, Christchurch. The subjects were equally divided into two treatment groups.

Conditions

(1) Cued. Five toy animals were placed on chairs around a small table. Five items of food were placed in a fruit bowl on the table. The subject was positioned where he could clearly see both the animals and the food. Before commencing the game each child was required to name all the animals and food items. When this had been successfully completed the experimenter explained the procedure and requirements of the game. The procedure was as follows: The experimenter stated each pairing to the child. This was done slowly and clearly at about approximately one pair each two seconds. When the instructions were completed the child was required to correctly pair the food items with the animals. This was a test of immediate recall of the experimenter's instructions. Following the first pairing there was a short rest period to allow the animals to 'eat' their meal. During this time the experimenter engaged the subject in conversation and quietly cleared away the food. The subjects were then required to 'feed' all the animals a second time.

The second feeding provided a test of longer term memory. Reminders of the game's requirements were given throughout.

(2) Non Cued. The procedure was exactly the same as for the cued condition except that while the experimenter was initially giving the pairing instructions, a large sheet was placed over the tables and chairs. The aim of the sheet was to stop the subjects from referring to the stimulus items during the instruction period. The cloth was quickly removed as soon as the instructions were complete, allowing the child to begin 'feeding' the animals.

Location of Testing

Testing was carried out individually in the teachers's office at the kindergarten. This was done to remove as many sources of distraction as possible.

RESULTS

The number of correct animal-food pairings is shown in Table 1. This indicates a fairly low level of retention on the part of four year old children and no difference between the cued and non cued conditions. The number of correct pairings can be compared with the number expected if subjects had paired animals with foods at random. If pairings were randomly determined the expectation is that 90.8% of the subjects would score two or fewer correct (see Appendix 1 for the derivation of this figure). Only two of eight subjects scored three or more in the test of immediate recall. However the more detailed analysis of results given in the last column of Table 1

Table 1 Level of performance for four year old subjects when recalling animal and food pairings

Condition	Subjects	Number Correct			Number of Identical Pairings - not Necessarily Correct
		Immediate Pairing	Second Pairing	Both Pairings	
No Cue	1	1	1	0	2
	2	1	1	1	5
	3	3	3	3	3
	4	2	2	2	5
Sub Total		7	7	6	15
Cue	5	0	0	0	5
	6	3	0	0	1
	7	2	2	2	3
	8	2	1	1	2
Sub Total		7	3	3	11
Total		14	10	9	26

indicates that five of the eight children achieved three or more identical pairings when reproducing their own previous animal to food matchings. There was therefore a tendency for subjects to recall their own initial pairings irrespective of whether they were correct or not.

The totals given in Table 1 suggest that four year old subjects forget a greater number of correct pairings between the first and second recall trials than their own idiosyncratic pairings.

CONCLUSION

Although the original aims of the study were not met the fact that the children showed a higher level of recall for their own actions than for the instructions given to them by the experimenter was seen to warrant further study.

PILOT STUDY 2

INTRODUCTION

It was observed in Pilot Study 1 that four year old children remembered a greater number of their own animal-food pairings (self determined), than those provided by the experimenter (experimenter determined). However, this occurred in a situation where subjects physically placed the objects in front of the animals (active participation). As active participation in the pairing was present in both conditions, the effects of experimenter determination as opposed to subject determination could not be separated.

It is therefore pertinent to investigate the effects on memory of active participation as distinct from observation, and of self determined and experimenter determined pairings. The main experiment to be reported in this thesis was designed to do this. However, a number of animal-food pairs needed to be chosen which would discriminate between various experimental conditions. The indication from Pilot Study 1 was that in the favourable conditions of self determined pairings and active participation, some four year old children are capable of retaining five pairs (Table 1).

Pilot Study 2 sought to provide information from which a suitable number of to-be-remembered pairs for seven to

eight year olds could be determined. Nine such pairs were used. Additionally it provided a trial run for the procedures of the main experiment.

METHOD

Subjects

Forty children of average to above average academic ability, as determined by their class teacher were selected from two Standard 1 classes at Ilam Primary School. Subjects were aged from 6.11 years to 7.8 years with a mean age of 7.4 years. All subjects were randomly assigned to one of four conditions. However, as testing commenced it soon became clear that the task of remembering the nine animal-food pairs was too easy for seven year old children. Consequently only a proportion of the original forty subjects were actually tested. The exact number used in each condition is given in Table 2.

Task

As with Pilot Study 1 subjects participated individually in a simple game, involving a pretend meal situation in which toy animals were 'fed' real items of food.

Stimulus Materials

The toy animals used were all those likely to be familiar to young children. A pool of the following thirteen animals was used from which nine was chosen for each subject: Elephant, panda, cat, golliwog, rabbit, hedgehog, rag doll, duckling, pig, dog, fish, teddy bear, buzzy bee. They ranged in height from 9 to 22 cms. The foods used were all real fruit and vegetables. As the

testing ranged over a period of several months a variety of foods were used depending on availability at the time. The following were used: A piece of cauliflower, potato, orange, onion, green pepper, carrot, parsley, mint leaves, lemon, apple, pear, plum, silver beet, peach, banana, tree tomato, brussel sprout and tomato. All were of as near equal size as possible. For the purposes of this study, nine of the animals and nine of the items of food from the respective pools were paired, avoiding any obvious relationship, e.g. on the grounds of similar colour or size. The animals were seated on the floor, with the foods in a fruit basket in the centre.

Procedure

All subjects were required to identify nine food and animal items. One Standard 1 pupil who was unable to do so was excluded from the study.

The experimenter explained the requirements of the game and stressed that each subject would need to remember the animal-food pairings as they would be required to give each animal the identical food later on. The subjects were reminded of these requirements throughout the course of the game. All subjects were required to pair all the animals with an item of food.

Four modes of presenting the to-be-remembered animal-food pairings were used

(1) Experimenter Determined-Observe (EDO). The pairing of animal and food items was made randomly by the experimenter who placed each item of food as close as possible to the

appropriate animal. The child was required to watch carefully as each pairing was made. As the pairing was made the experimenter labelled it verbally, e.g. "The cat is being fed the lemon."

(2) Experimenter Determined-Active (EDA). As in the EDO condition the experimenter determined the pairings but in this condition the subject was required to place the food beside each animal when instructed by the experimenter. This involved active participation in the memory game. As the experimenter's instructions were virtually simultaneous with the child's pairing, instruction was seen to be equivalent to labelling.

(3) Self Determined-Observe (SDO). In this condition the subject determined the pairing of animal and food and instructed the experimenter, who placed the food as close as possible to the animal. The experimenter stated the pairing verbally as the food was placed beside the animal. There was no active participation in this condition but the subject was able to impose his own relationship on the to-be-remembered items.

(4) Self Determined-Active (SDA). The child determined the pairings and also performed the pretend feeding. As in the above condition the experimenter verbalized each pairing as it was performed by the child.

After the initial feeding was completed the child was asked to select a book from a number selected at random from the library by the experimenter or class teacher. The child was seated facing away from the animals and

the experimenter involved the child in conversation about the book for about three to five minutes. This period was fairly flexible so as to place the child at ease. The child was not required to actually read but to comment on the pictures and story outline. During this time the experimenter quietly cleared away the food and placed it in the fruit basket in the centre of the circle of animals.

The child was then informed that the animals were hungry and that each animal would like to be given the same food as they had 'consumed' at the previous meal. No help was given by the experimenter and the child was not told whether the pairings were the same as those given before. After the completion of the second 'feeding' the child was thanked and returned to the classroom.

Instructions

As previously mentioned all subjects were told that to play the game they would have to remember which animal had been given which food and that after a short delay (to give the animals time to 'eat' their 'breakfast/lunch'), they would be required to give each animal exactly the same food as before. Reminders of these instructions were given throughout the game. No help was given by the experimenter. It was also stressed that food given to the animals was not what they ate in real life.

At the end of the game the experimenter again stressed that all the animals should each have the food they had been given previously by themselves (SDA or EDA) or by the experimenter (SDO or EDO).

Location of Testing

Testing was conducted individually in a quiet area of the school, generally either a spare classroom or the library.

Recall Test

Level of recall was taken to be the number of pairings made by the subject in the recall trial (second feeding), that were identical to those made during initial presentation. The maximum score for this study was nine identical pairings.

RESULTS AND CONCLUSION

The major purpose of Pilot Study 2 was to assist in determining a suitable number of pairs for use with seven year old children. Results are given in Table 2.

Table 2 Mean recall score using nine stimulus items for seven to eight year old children.

Conditions	SDA	SDO	EDA	EDO
Number of Correct Pairings	6.8 n = 4	6.8 n = 4	7.0 n = 9	6.4 n = 10

Since some subjects in the various conditions recalled all nine pairs, and 82% recalled in excess of six, it is clear that a larger set is needed for use with seven to eight year old children if a task capable of discriminating the effects of the various conditions is to be used.

The main study was therefore designed to further examine the findings of the pilot studies, looking at the effect of active participation and self determined pairing of memory items on subsequent recall performance in seven and four year old children.

MAIN STUDY

INTRODUCTION

This study sought a developmental comparison of the effects of participation (active and observe), and determination of pair relationship (self determined and experimenter determined), on the ability of four to five and seven to eight year old subjects to retain animal-food pairs using the task outlined in Pilot Study 2.

METHOD

Subjects

(1) Seven to Eight Year Old Subjects. Eighty children, aged from 7.1 to 8.1 years (mean age 7.6 years), were selected from Westburn School and Fendalton Open Air School. Both were situated in middle to high income areas in Christchurch. Evidence for this assumption came from the generally high standard of housing in the area and the occupational level of most of the subjects' parents. All subjects were in Standard 1 classes and were of at least average academic ability as determined by their class teacher. The subjects were equally divided for sex and were randomly placed into into the four treatment groups.

(2) Four to Five Year Old Subjects. Eighty children aged from 4.0 to 4.11 years (mean age 4.7 years) were randomly selected from three Christchurch kindergartens (Fendalton, Avonhead and McKenzie Kindergartens). Most of

the children would subsequently attend the two primary schools used in the study and the assumption was made that most children in the two age groupings came from similar home backgrounds. The children were equally divided for sex and randomly placed with ten of each sex in each of the four treatment groups.

Before testing commenced, one morning had been spent at each kindergarten to give the children time to get to know the experimenter.

Stimulus Materials

On the basis of pilot studies it was decided to use lists consisting of nine animal-food pairs with four year olds, and of twelve pairs with the seven year old subjects. Also at the time of recall an additional two foods were made available so that nine of eleven and twelve of fourteen foods had to be matched to nine and twelve animals respectively for the four year and seven year old groups. The additional foods were included to reduce the likelihood of correct pairings arising as a result of guessing on the part of subjects who correctly retained a near total number of correct pairings. The two extra items were incorporated into the game as extra food for 'second helpings' and were left in the basket at the completion of the final pairing.

Task/Procedure

Details of the game and the procedure are given in the Method section of Pilot Study 2.

Treatment conditions remained unaltered and were as follows:

(1) Experimenter Determined-Observe (EDO)

(2) Experimenter Determined-Active (EDA)

(3) Self Determined-Observe (SDO)

(4) Self Determined-Active (SDA)

Instructions

An attempt was made to ensure that all the subjects, especially the younger ones understood in broad terms what remembering meant. Each child was asked for a simple explanation of remembering. The responses given by the subjects were in agreement with those obtained by Kreutzer et al.(1975) who found that by age four, children have some concept of remembering and forgetting.

Recall Score

The recall score for the main study was out of a total of nine possible identical pairings for the four year old children, and twelve possible pairings for seven year old subjects.

C H A P T E R I I I

RESULTS

Within each age group the design involved the factors: Activity (Active and Observe), Pair relationship (Self Determined and Experimenter Determined), and Sex. Separate 3-way Anovas for the two age groups were performed on the total number of correct pairings, using the Biomedical Statistical Package Program BMD08V. Separate analyses were required for seven year old and four year old subjects because a different total number of animal and food pairings had been used for the two age groups (twelve for the seven year olds and nine for the four year old subjects, as reported in Chapter II).

Due to early fears about the influence of chance factors, a forced choice score had been included. This involved the experimenter randomly selecting six animals at the start of the recall trial. These animals had to be paired with food at the commencement of the trial. However a number of serious problems arose. The major one concerned a failure by some of the four year old subjects to obey the forced choice instructions. In a number of cases the subject had firm ideas about which animals were the hungrier. Observation by the experimenter showed these to be pairings that had been correctly retained by the child. Although this demonstrates

the child's involvement in the game and his comprehension of the requirements of the task, it introduced a serious source of error into any forced choice score. A combination of the above problems and the results of the calculations shown in Appendix 1, indicating that high levels of performance were extremely unlikely if a random matching of foods to animals occurred, led to the abandonment of the forced choice score.

SEVEN TO EIGHT YEAR OLD SUBJECTS

If subjects had paired on a random basis the expectation is that 98.1% of them would have achieved three or fewer correct pairings (see Appendix 1 for the derivation of this value). As only 15% of subjects obtained fewer than three correct, their performance is clearly above chance level.

Means and standard deviations of total scores are given in Table 3. The Anova summary table is shown in Table 4. There were no significant effects which indicates that active participation and self determination of animal-food pairings have little effect on the memory performance of seven to eight year old children.

FOUR TO FIVE YEAR OLD SUBJECTS

Means and standard deviations of the recall scores are shown in Table 5 and the means are presented in Figure 1. If subjects had been responding on a chance basis (refer to Appendix 1) the expectation is that 95.5% of the

Table 3 Means and standard deviations of the number of correct pairings of seven to eight year old children

	Active		Observe	
	Boys	Girls	Boys	Girls
Self Determined				
Mean	7.2	7.3	6.2	5.8
Standard deviation	2.11	2.97	2.20	3.80
Experimenter Determined				
Mean	5.3	6.5	5.6	7.1
Standard deviation	2.81	2.64	3.10	2.13

Table 4 ANOVA Table of the number of correct pairings of seven to eight year old children

	Source	SS	df	MS	F
Sex	X	6.05	1	6.05	0.856
Pair relationship	M	5.00	1	5.00	0.708
Activity	A	3.20	1	3.20	0.453
	XM	12.80	1	12.80	1.811
	XA	0.0	1	0.0	0.0
	MA	14.45	1	14.45	2.045
	XMA	0.45	1	0.45	0.064
	Within groups	508.80	72	7.07	
	Total	550.75	79		

Table 5 Means and standard deviations of the number of correct pairings of four to five year old children

	Active		Observe	
	Boys	Girls	Boys	Girls
Self Determined				
Mean	5.5	6.6	4.9	5.7
Standard deviation	1.5	1.99	1.83	0.11
Experimenter Determined				
Mean	4.4	4.4	1.7	3.2
Standard deviation	1.96	3.06	1.27	2.91

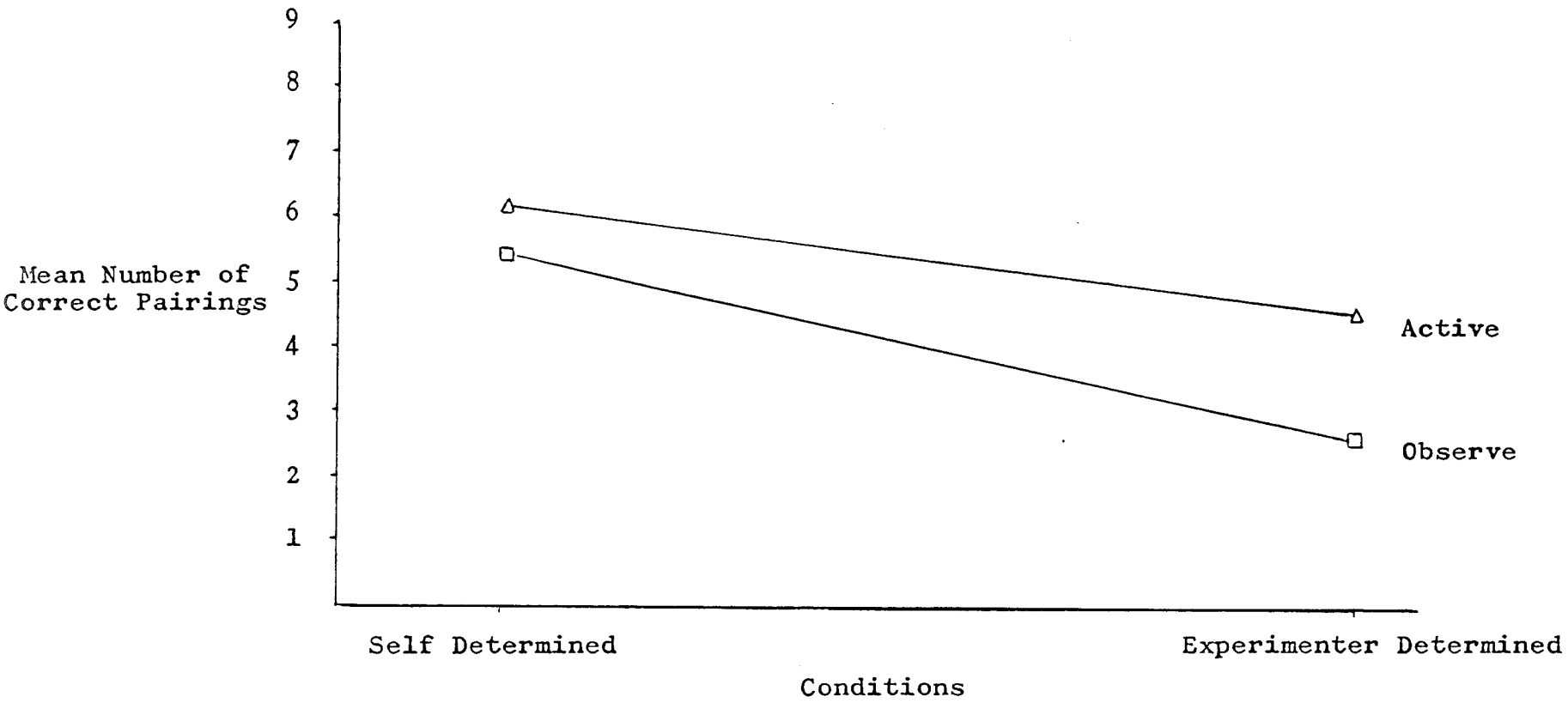

Figure 1 Mean number of correct pairings of four to five year old children

children would achieve three or fewer identical pairings. This value is clearly exceeded in all but the EDO condition. Subjects in this condition effectively recalled none of the original pairings.

The data indicates that there are distinct trends in the levels of recall over the four treatment conditions. The relevant Anova is reported in Table 6. This shows a significant sex main effect with girls typically making more correct pairings than boys. None of the interactions involving sex were significant. The pair relationship and activity main effects were also significant confirming the trends displayed in Figure 1. There were a greater number of identical pairings in the self determined than experimenter determined conditions. Performance was also higher where subjects actively manipulated the foods rather than observed.

Simple main effects were calculated to locate significant differences between conditions. There was a tendency, approaching significance, for recall under active participation to exceed that of the observe condition for self determined pairings, $F(1,72) = 3.21$, $.05 < p < .10$. Active participation did produce significantly higher levels of performance than observation of experimenter determined pairings, $F(1,72) = 21.73$, $p < .001$. Active participation therefore appears to result in higher recall than observing, this is more marked using experimenter determined pairing.

Table 6 ANOVA Table of the number of correct pairings of four to five year old children

	Source	SS	df	MS	F	p
Sex	X	14.45	1	14.45	8.23	<.01
Pair relationship	M	101.25	1	101.25	57.67	<.001
Activity	A	36.45	1	36.45	20.76	<.001
	XM	0.20	1	0.20	0.11	NS
	XA	1.80	1	1.80	1.03	NS
	MA	7.20	1	7.20	4.10	<.025
	XMA	4.05	1	4.05	2.31	NS
	Within groups	126.40	72	1.75		
	Total	291.80	79			

The recall of self determined pairings was found to be superior to experimenter determined pairings in both the active, $F(1,72) = 15.56$, $p < .001$, and observe conditions, $F(1,72) = 46.41$, $p < .001$, although the effect of self determination of pairings is apparently greater under observe conditions.

Active participation therefore appears to result in higher recall than observe conditions. This is most marked using experimenter determined pairing, but is also demonstrated when the subject forms his own animal-food pairs.

COMPARISON BETWEEN AGE GROUPS

The results of the seven to eight year old children in Pilot Study 2 can be compared with the four to five year old children in the main study. Both used nine pairs, although the seven year old subjects were not given the two extra items in the recall trial. This was not seen to effect the results to any great extent, although the four year old scores may have been somewhat depressed in relation to the seven year old subjects performance because of the increased number of food items in the recall trial. With this point in mind a comparison can still be made. The relevant data is presented in Table 7.

The most interesting finding is the comparison of the two self determined conditions for the two groups. T tests indicated that there were no significant differences

Table 7 Comparison between seven to eight year old and four to five year old children's recall performance

Conditions	Nine Possible Pairings		Twelve Possible Pairings
	4-5 Year Old Subjects	7-8 Year Old Subjects	7-8 Year Old Subjects
SDA	6.05	6.80	7.25
SDO	5.30	6.80	6.00
EDA	4.40	7.00	5.90
EDO	2.45	6.40	6.35

in the levels of responding in the self determined conditions for seven and four year old subjects. However although the self determined active condition was clearly not significant, differences in performance in the self determined observe condition did approach significance, $t(22) = 1.94$, $.05 < p < .10$.

The highest level of recall and thus the most favourable memorizing condition for four year old subjects in this study was obtained in the self determined active condition. This indicates that when four year old children are placed in what for them is a favourable situation, their performance is close to that of seven year old children.

Although 6.8 identical pairings appears to be close to the upper limit for the seven year olds (refer to column 3 of table 7, which indicates that even with twelve items, mean recall level is only 7.25 pairs). Four year old children might also be able to recall a higher number of pairings if the total number of pairs were increased, for example to twelve items. In less favourable situations the four year old children performed at a much lower level than the seven year olds. For the experimenter determined active condition, $t(27) = 4.12$, $p < .001$, 2 tail, indicating a significant difference in the performance of four year old and seven year old children using nine pairs. A similar result was obtained for the experimenter determined observe condition $t(28) = 6.05$, $p < .001$, 2 tail.

From these results it appears that given conditions favourable to the implementation of mnemonic strategies available to the four year old they perform as well as older children. This emphasizes the point that young children are influenced by prevailing environmental conditions to a greater extent than seven year old children.

C H A P T E R I V

DISCUSSION

The impetus for the main study came from Pilot Study 1. The finding that active participation appeared to be important in determining what young children remembered, led to an investigation of the role active participation may play in the recall of memory items. The results of Pilot Study 1 also relate to a study by Wolff et al. (1974) which as previously outlined (p. 12), reported that five year olds who were permitted to actively produce an interaction between two, to-be-remembered items, recalled more items after twenty-four hours than children who had observed the interaction being made. However Wolff et al. failed to separate the effects of active participation and self determined pairing (p. 17). The present study was designed to look at this question and untangle the problem of whether it was the opportunity to determine item pairings or the motor activity involved in making them that led to improved recall in children of different ages. However in the present study subjects in the self determined conditions formed their own item pairings as in the study by Wolff and Levin (1972), rather than forming their own interactions with predetermined pairs as in the Wolff et al. (1974) study.

SUMMARY OF RESULTS

The results indicated that the recall performance of four year old subjects was superior when they were able to actively form the experimenter determined pairings (EDA) than in conditions where they passively observed the experimenter making the pairings (EDO). Self determination was shown to lead to higher levels of retention than experimenter determined pairing under active conditions.

When four year old children observe their own pairings being made they recall more than if they watch experimenter determined pairings being made. However it is unclear from this data whether it is the act of instructing the experimenter to make the pairings, which may act as a form of labelling, or actually creating them in the SDO condition which leads to improved performance over the EDO condition.

Comparison of four and seven year olds was made, where both used nine stimulus items. In the experimenter determined conditions, four year old subjects performed at a considerably lower level than the seven year olds, indicating that in conditions of experimenter determined pairing, a developmental improvement appeared to be present. However, in the self determined active and observe conditions, performance of four year old subjects was close to the level of recall for seven year old children. This trend was particularly marked in the self determined active condition.

The non significant differences in the level of performance over the four conditions for seven year old children can be attributed to their ability to utilize suitable mnemonic strategies. Support for this idea comes from work by Varley et al. (1974). These authors found that motor training aimed at improving recogniton performance had no effect on six to seven year old children. They concluded that children of this age were able to produce their own dynamic images and thus training had no effect on improving recognition. The same study also used four to five year old subjects and found a significant improvement in recognition after the motor training procedure. The results of the present study seem to indicate that recall performance functions in a similar way. It would appear that seven to eight year old children were able to store the pairings for future retrieval and to implement strategies to achieve this goal.

An additional explanation for the pattern of results comes form work by Bender and Levin (1976) who put forward the suggestion that children of over seven years are able to foresee memory demands and plan strategies in advance to cope with these future demands. Their results showed that seven year old children carry out this planning while observing, whereas four year old do not. This may explain the finding that memory performance was unaffected by variations in participation in seven to eight year old children. If Bender and Levin (1976) are correct, the

children were actively planning and putting into operation effective memory strategies. Four year old subjects, on the other hand, failed to plan ahead during passive observation and as a result produced a lower level of recall than the other conditions.

The findings of this study help to reconcile the differences between the work of Wolff and Levin (1972) and Yuille and Catchpole (1973). The point was made in Chapter 1 that the above studies used different age groups. Wolff and Levin (1972) used five year old children and found that activity improved the retention of paired-associates, whilst Yuille and Catchpole (1973) used seven year old subjects and found it did not. The results of the present study indicated that seven to eight year old subjects were not significantly affected by active participation, while four to five year olds were. The difference between Wolff and Levin (1972) and Yuille and Catchpole (1973) may result from their using subjects of different ages.

A major importance of this study is that it has demonstrated the effectiveness of using three dimensional objects in a realistic situation. It seems that knowledge of how children operate in real world situations is vital to our understanding of the principles of child development. As a result a great deal more study should be undertaken using realistic and meaningful situations.

An interesting comparison can be made between the performance of four year old girls and all seven year old subjects. It would appear that four year old girls possess the required mnemonic skill when placed in a favourable memory situation, i.e. SDA, to perform at a level closely approximating that of seven year olds of both sexes in all conditions. Although the data of Pilot Study 2 does not enable the separation of performance on the basis of sex, the results of the main study indicate that there were no significant sex differences in the level of performance for seven year old subjects. Four year old girls were also superior to four year old boys in the SDO and EDO conditions, as shown by the significant main effect for sex. It can be tentatively concluded that four year old boys still lack the mnemonic strategies necessary to increase their level of recall. An alternative explanation for the higher performance displayed by four year old girls is that they may have been more interested and motivated by the game and therefore produced an increased recall score over that of four year old boys.

The finding that self determined pairings led to a higher level of recall is unexpected as it is contrary to the findings of Wolff and Levin (1972). In the latter study, experimenter determined pairing led to improved performance over self determined pairings. However, Mal'tseva (cited in Smirnov, 1973), found that memory

aids created by the subject were more effective in aiding recall than those created by the experimenter. She concluded that subject created aids were likely to be more meaningful. This may account for the superiority of subject determined pairings for kindergarten (four year old) subjects in this study. All the four year old subjects were familiar with the toys used in the game and the formation of relationships between toys and other objects is common place during the play experience of most young children. Thus the creation of meaningful relationships with real toys lay within the capabilities of a young child. In addition the opportunity to form these relationships may have added meaning and interest to the game which helped to involve the child in the game, thereby producing a higher level of retention. Evidence for this comes from the higher although not significantly so, level of SDA performance as compared with the SDO condition. The more the child participated in the game the better subsequent recall. Mal'tseva would also have predicted a higher level of memory performance in the self determined conditions of seven year old subjects, however this was not demonstrated here. A possible explanation for the difference is that in this study all the items were concrete and meaningful, whereas Mal'tseva used words. As the seven year olds in the present study identified the mnemonic goal they formed memorable relationships between items in all conditions.

EDUCATIONAL IMPLICATIONS

From this data it would appear that four to five year old children have a poor memory for experimenter determined material, whereas New Zealand children, by age seven to eight can recall experimenter determined material as well as self determined material. It may be that this improvement is due not only to natural developmental changes but to skills acquired at school, where instructional methods tend to predominate. A slightly superior performance exhibited by these New Zealand seven to eight year olds over American children of the same age, used in the Wolff studies was demonstrated. Some of the American subjects were unable to spontaneously produce dynamic imagery as a mnemonic tool. The fact that New Zealand seven year old children have spent longer in school (from age five), may be at least partially responsible for their superior performance. Evidence for this can only be obtained from comparative research.

POSSIBLE AREAS OF FUTURE INTEREST

In attempting to answer a number of questions this study has raised several more. Firstly, what would be the level of performance of four year old children under self determined active and observe conditions, using twelve items instead of nine? It is possible that given more items to remember they would respond at an even higher level, on the other hand, twelve items may result in a lack of interest and loss of attention towards the items with

a consequent reduction in recall. A second question that has been raised is the problem of whether the recall level in the SDO condition was significantly higher than the EDO condition, because the four year olds were forming their own meaningful memorable relationships or whether the act of instructing the experimenter acted as a form of labelling to increase subsequent recall (Wilgosh, 1975)?

By only using two age groups the question arises as to the ages at which the changes in memory behaviour occur, i.e. the onset of the ability to utilize effectively various memory strategies. The change could be the result of a natural developmental change, as Piaget would suggest, or it could be influenced by school attendance and the introduction of an instructive method of teaching when the child begins school. It would also be interesting to determine whether the improvement in memory performance continues to increase with age. The introduction of a group of nine to ten year olds would be relevant in this context. Several other studies (Appel et al., 1972; Flavell et al., 1970) used children of this age and found that they were beginning to display mature mnemonic behaviours, whereas seven to eight year olds did not. It would be interesting to determine the memory performance of older children using real objects in a game situation.

The finding that more mature memory behaviour occurs in a play situation than in a laboratory setting in children of similar ages (Istomina, 1975), indicates that a new developmental framework needs to be established, concerning the memory performance of children in real life situations

using real objects. It would appear that such a framework would demonstrate that children who were placed in such an environment would demonstrate a superior level of memory behaviour than children of the same age in a laboratory situation.

CONCLUSION

This study has utilized a realistic game situation using concrete meaningful objects to demonstrate that when using experimenter determined material, memory performance in four to five year old children is improved if these children can participate actively in the game. Performance is still further improved if they can form their own pairing between to-be-remembered items. However, due to the effective use of appropriate memory strategies and a generally higher level of mnemonic awareness, seven to eight year olds perform equally well in all conditions.

Given the more favourable conditions of active participation using self determined pairing the memory performance of four year old girls approximates that of the seven year old subjects, suggesting that the use of memory strategies, effective in the context of this study is developed earlier by girls.

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APPENDIX 1

DERIVATION OF EXPECTED NUMBER OF CORRECT ANIMAL-TO-FOOD PAIRINGS

The present tasks involve the pairing of animals with foods on separate occasions, the statistic of interest being the number of identical pairings on separate occasions. With the exception of the last column of Table 1, Pilot Study 1, in the present case this statistic refers to the number correct. With a set of n animals and n foods, the probability of obtaining r identical pairings if the foods are randomly matched on the second occasion is, according to David & Barton (1962, p. 105), given by

$$p(r) = \frac{1}{r!}\left(1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \ldots\ldots\ldots (-1)^{n-r}\frac{1}{(n-r)!}\right)$$

Derivation of values of p(r) for the Main Study (Chapter 3) where the number of foods exceeds the number of animals by two, is not given by the above formula. Its application in these circumstances will result in an over-estimation of values of p(r) for small r. Values of p(r) generated by the above formula for the various values of n which were used in the studies reported in this thesis are given below in Table 8.

Table 8 Probability of obtaining various numbers of correct animal-food pairings if subjects matched randomly

Number Correct	Number of Animals					
r	5		9		12	
0	.36666		.36788		.36684	
1	.37500		.36788		.36684	
2	.16667		.18393		.18342	
3	.08333		.06134		.06114	
4	.00000	.0917	.05128		.01528	
5	.00833		.00312		.00305	
6			.00046		.00051	
7		.05496	.00010	.0189	.00007	
8			.00000		<.00001	
9			<.00001			
10						
11						